The Effect of Managerial Ability on Farm Financial Success

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The effects of managerial ability on farm financial success are analyzed for a 1990 sample of Pennsylvania commercial dairy farms using structural latent variable techniques. Latent factors related to dairy, crop, and financial management are used with herd size to explain farm financial success, measured by net farm income. Results indicate the relative importance of each management variable toward farm financial success.

Introduction

Agricultural professionals have long recognized that differences in managerial ability will result in differences in financial success of farms with similar resource bases under the same production conditions. Managerial ability is quite difficult to measure, however, when trying to determine its effect on farm financial performance. Its omission from the specification of economic models results in bias in estimated parameters. Measurement errors lead to the same problem when efforts are made to include the managerial ability variable in a model specification. Historically, the accounting for managerial ability in production functions and estimates of technical efficiency in published research has rarely led to specific prescriptions for an agricultural industry. The magnitude of (in)efficiency is determined, but specific recommendations for any improvement in efficiency, and farm profitability, are often beyond the scope and level of detail of estimated models.

The effect that management has in biasing estimated technical and economic relationships has been recognized by economists for many years (Griliches; Mundlak; Dawson). Managerial ability has been included in a number of studies of agricultural producers. Typically, managerial ability was represented in regression models as a set of demographic variables or production practices as proxies for unobserved managerial ability (Bigras-Poulin et al.; Sumner and Leiby; Bailey, et al.; Mykrantz, et al.). Other studies have incorporated management levels into simulation models through efficiency of input use (Patrick and Eisgruber), profitability (Musser and White), expert opinion (Antle and Goodger), and business motivations (Young, et al.).

Dairy farms, in particular, require broad management expertise in managing the dairy herd, the crop program, and farm finances. The complexity of these farm operations may make it difficult for dairy farm managers to excel in all three management areas. The relative importance and contribution of the farm operator's managerial ability in each area is of interest to researchers investigating determinants of dairy farm financial success. Many studies have related dairy farm production practices, farmer age and experience, and efficiency measures to farm profitability measures through regression analysis (Carley and Fletcher; Haden and Johnson; Kauffman and Tauer; McGilliard, et al.; Williams, et al.). Sometimes, relative measures of dairy farm efficiency are related to farm characteristics in an effort to identify determinants of efficiency. Again, production practices, farm facilities, and farmer demographic information were used as measures of managerial ability (Bailey, et al.; Kumbhakar, et al.; Stefanou and Saxena). Several studies have gone further to relate technical and/or allocative efficiency to specific farm characteristics and production efficiency measures (Weersink, et al.; Tauer and Belbase; Tauer; Bravo-Ureta and Rieger; Grisley and Mascarenhas). These studies have generally found that these measures explain only a small portion of total variability in efficiency for the dairy farms included in the respective studies.

There is no clear consensus arising from previous research on what variables represent management or whether they accurately measure ability in herd, crop, and financial management. Further, there has been no strong link made between man-

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agerial ability and farm financial success or efficiency. Typically, measurement error still exists in these model specifications. These concerns are addressed in this study through a model relating farm financial success to managerial ability using a 1990 sample of Pennsylvania dairy farms. A methodology is developed that relates latent management variables to net farm income and evaluates their individual impacts on financial success. The relative impacts of three types of managerial ability are assessed, as are the individual impacts of the observed indicators of these latent variables.

Model Development

The primary objective of this analysis is to relate a measure of dairy farm financial success, y, to unobserved measures associated with financial managerial ability, ξ_f, dairy managerial ability, ξ_d, and crop managerial ability, ξ_c. The structural latent variable approach is used for two reasons. First, there are numerous economic, accounting, and efficiency variables which could represent the measures of interest. Second, if a multiple regression approach is used to try to infer the interrelationships among these related variables, it is likely that the high intercorrelations among variables would yield puzzling, inconclusive or contradictory results. The attraction of structural latent variable analysis stems from its ability to exploit the interrelationships among variables which are thought to indicate some underlying component or factor (Goldberger).

The model to be developed represents the relationship between dairy net farm income, y, and factors associated with financial, dairy and crop management, i.e.,

$$y = \gamma_1\xi_f + \gamma_2\xi_d + \gamma_3\xi_c + \zeta \qquad (1)$$

Estimation of the unknown parameters, γ_i, is not straightforward since the independent variables are not directly observed; hence, minimization of the (squared) residual, ζ, using ordinary regression techniques is not a feasible method for obtaining parameter estimates.

Instead, confirmatory factor analysis (Bollen; Kim and Mueller) is used to specify the relationships among indicators of the latent variables. Confirmatory factor analysis differs from exploratory factor analysis in that a structure of underlying relationships is imposed on the data instead of letting the data define the relationships. Although we do not observe the independent variables directly, we do observe indicators of these variables. We can then infer factors of proportion between indicators and latent variables. Using this structure, the second moments of equation (1) are completely specified and maximum likelihood methods can be used to estimate the γ_i.

The confirmatory factor analysis approach can be represented as:

$$x = \lambda\xi + \epsilon, \qquad (2)$$

or

$$\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_k \end{bmatrix} = \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \vdots \\ \lambda_k \end{bmatrix} \xi + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_k \end{bmatrix}$$

where the observational subscript has been suppressed. Here, the k variables in the x vector serve as indicators of the latent variable of factor ξ. The elements of the λ vector are termed factor loadings or structural coefficients. The contribution of the i^{th} indicator toward explaining ξ depends on the magnitude of λ_i and the variance of ϵ_i. This can be seen by forming the second moment of (2), i.e.

$$Cov(x) = \lambda\phi\lambda' + V_\epsilon = \Sigma_{xx}(\theta) \qquad (3)$$

where ϕ is the variance of ξ and

$$V_\epsilon = \begin{bmatrix} \sigma_{11} & 0 & \dots & 0 \\ 0 & \sigma_{22} & \dots & 0 \\ \vdots & & \ddots & \\ 0 & \dots & 0 & \sigma_{kk} \end{bmatrix} \qquad (4)$$

$\Sigma_{xx}(\theta)$, then, represents the covariance of the x matrix in terms of all of the unknown parameters in equations (1), (2), and (3). Note that each x_i is an imperfect indicator of ξ as long as $\sigma_{ii} > 0$. Also, since scale rather than location is of interest, the indicators are typically centered about zero and one of the λ_i is normalized to unity.

Estimation of the loadings and variances (the elements in θ) uses the second moment formulation in (3) where the observed second moments of the indicators are equated to the unknown parameters of $\Sigma(\theta)$. The log likelihood function under the assumption of normally distributed data is (Bollen, p. 133)

$$-.5N ln[\det(\Sigma_{xx}(\theta))] - .5\, N tr(\Sigma_{xx}(\theta)^{-1}S_{xx}) \qquad (5)$$

where N is the sample size, *ln* is the natural logarithm, det is the determinant of a matrix, *tr* is the trace of a matrix, and S_{xx} is $Cov(x)$, the covariance matrix of the observed indicators.

Generalization of (2) through (5) to more than one factor is straightforward. For the case of g factors, λ becomes a kxg matrix, ξ is gx1, and Φ

is gxg. The latent variable model in equation (1) also requires the estimation of a regression with latent variables as regressors. This is accomplished by noting that:

$$y = \xi'\gamma + \zeta \tag{6}$$

The second moment of (6) is

$$Var(y) = \gamma' E(\xi\xi')\gamma + \Psi \tag{7}$$

where E is the expectation operator and Ψ is the variance of ζ. Substitution of the second moment of y implied by equation (1) yields

$$Var(y) = S_{yy} = \gamma'\Phi\gamma + \Psi = \sum{}_{yy}(\theta) \tag{8}$$

Estimation of all the parameters in the system can be achieved by generalizing (5).

Let $S =$

$$\begin{bmatrix} S_{yy} & S_{yx} \\ S_{xy} & S_{xx} \end{bmatrix} \text{ and } \sum(\theta) = \begin{bmatrix} \Sigma_{yy}(\theta) & \Sigma_{yx}(\theta) \\ \Sigma_{xy}(\theta) & \Sigma_{xx}(\theta) \end{bmatrix}$$

Recognizing that

$$S_{yx} = \lambda\Phi\gamma = \Sigma_{yx}(\theta) \tag{9}$$

permits writing the log likelihood function as

$$-.5Nln[\det(\Sigma(\theta))] - .5Ntr(\Sigma(\theta)^{-1}S). \tag{10}$$

Model Specification

A statistical model was developed to determine the impact of managerial ability in three management areas (finance, dairy, and crops) on net farm income. The three unobserved factors ξ_f, ξ_d, and ξ_c are related to respective unobserved indicators according to the specification presented in (11).

$$\begin{bmatrix} EA \\ MARG \\ INT \\ DEBT \\ MCOW \\ VET \\ CALF \\ MMAN \\ ACOW \\ AMAN \\ EXP \\ YLDS \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \lambda_1 & 0 & 0 \\ \lambda_2 & 0 & 0 \\ \lambda_3 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & \lambda_4 & 0 \\ 0 & \lambda_5 & 0 \\ 0 & \lambda_6 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & \lambda_7 \\ 0 & 0 & \lambda_8 \\ 0 & 0 & \lambda_9 \end{bmatrix} \begin{bmatrix} \xi_f \\ \xi_d \\ \xi_c \end{bmatrix} + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \epsilon_4 \\ \epsilon_5 \\ \epsilon_6 \\ \epsilon_7 \\ \epsilon_8 \\ \epsilon_9 \\ \epsilon_{10} \\ \epsilon_{11} \\ \epsilon_{12} \end{bmatrix} \tag{11}$$

The financial management factor, ξ_f, is indicated by the degree of leverage employed, as represented by the equity to asset ratio (EA), the gross profit margin (MARG), interest expense as a proportion of total cash expenses (INT), and debt per cow (DEBT). EA is calculated as farm net worth divided by total assets, both valued at market value. MARG is calculated by dividing total cash sales into total cash expenses and subtracting that proportion from one. INT and DEBT are self-explanatory. It is hypothesized that the relationships between financial managerial ability and EA and MARG will be positive, while those between financial managerial ability and INT and DEBT will be negative, i.e., $\lambda_2,\lambda_3 < 0$.

The dairy management factor, ξ_d, is indicated by the dairy efficiency factors: milk sold per cow (MCOW), veterinarian expenses per cow (VET), heifers and calves per milk cow (CALF), and milk sold per man (MMAN). Dairy managerial ability is expected to vary directly with all four indicators. Summary analysis suggests that net farm income increases with milk per cow, while veterinary costs and the ratio of youngstock to cows increase with milk sold per cow (Ford and McSweeny). However, VET and CALF may be inversely related to dairy management on some farms.

The crop management factor, ξ_c, is indicated by the variables: crop acres per cow (ACOW), crop acres per man (AMAN), crop expense per acre (EXP), and a constructed relative yield index for each farm (YLDS). Crop acres used to calculate ACOW and AMAN are acres planted. EXP includes only the direct variable crop expenses of fertilizer, seed, and chemicals. The yield index constructed for this model, YLDS, reflects the fact that not all farmers grow the same crops. Direct crop yields cannot be used since any farm not growing a specific crop would show a yield of zero. Consequently, an index was constructed where corn grain, corn silage, and all hay yield indices were calculated for each farm as a proportionate difference from the average yield of those farms that produced those respective crops. The result is a measure relating to the sample average for each crop grown on each farm. These crop indices were then weighted by the acres for each crop grown on the farm to arrive at the final average yield index for that farm. A measure of −0.20, for example, means that the crop yields on that farm were 20 percent below the average for the sample, while a measure of 0.20 indicates that the yields on that farm were 20 percent above the sample average. It is expected that the indicator variables ACOW, AMAN, and YLDS will vary directly with crop managerial ability, since the ability to provide adequate feed, labor efficiency, and crop productivity are all associated with good management. Weather, of course, will also affect crop yields implying that the yield index is not a perfect indicator of crop managerial ability. No hypothesis is made regarding the relationship of EXP to managerial ability, since both high and low expenditures per acre can be associated with poor management.

The interpretation of the latent factors, ξ_i, will be determined by the pattern of signs of the factor loadings, λ_i, which establishes the relationship between the factors and their indicators. The interpretation of the estimated loadings of the indicators on their respective management factors will be discussed in the results section. The impacts of the three management factors on dairy farm financial success can then be assessed using equation (1).

A final specification issue relating to size effects needs to be considered. To account for the effect of firm size on net farm income, the size of the dairy operation should be introduced. Herd size (HS) is therefore included in equation (1) as an additional regressor giving

$$y = \gamma_1\xi_f + \gamma_2\xi_d + \gamma_3\xi_c + \gamma_4 HS + \zeta \quad (1^*)$$

The system of equations including (1*) and (11) can be estimated by maximizing the full information log likelihood function given by (10).

Data and Model Estimation

The statistical model developed in this study was estimated using data from a sample of 880 Pennsylvania commercial dairy farms for 1990. The data were gathered through a tax and record-keeping service provided by Pennsylvania Farmers' Association. The data are not statistically representative of Pennsylvania's dairy industry, however they do represent a wide range of dairy farms in the state. The farms included in the sample have at least 20 milk cows and at least 50 percent of gross farm income coming from milk sales. The average contribution of dairy to gross sales is 93.2 percent for the sample. The sample means of the variables specified in the model presented in the previous section are presented in Table 1.

The maximum likelihood estimator of the structural latent variable model presented was derived under the assumption of normally distributed data. Clearly many measures of farm finances and operating characteristics are not normally distributed, and no such claim is made for the data used in the analysis. Instead, pseudo-maximum likelihood estimation (Gourieroux, et al.) is used to obtain parameter estimates. The conditions under which pMLE estimation is valid require only that the conventional normal log likelihood function produce consistent estimators. Then, the variances for these estimators must be adjusted to account for the fact that the true underlying distribution is not normal (White; Gourieroux, et al.).

Browne has shown that the normal MLE estimator of the structural latent variable model is consistent under distributional misspecification. Fuller (p. 347) notes that normal distribution maximum likelihood procedures possess desirable asymptotic properties for a wide range of distributions. To compute the covariance matrix of the estimated

Table 1. Variable Names, Definitions, and Sample Means*

Variable Name	Definition	Sample Mean	Standard Deviation
Dependent Variable			
NFI	Net farm income	$32,597	$36,190
Financial Management Indicators			
EA	Equity to asset ratio	74%	23%
MARG	Operating margin	26%	13%
INT	Interest as a % of cash expenses	8.8%	7.0%
DEBT	Debt per cow	$2,234	$2,000
Dairy Management Indicators			
MCOW	Milk sold per cow (lbs)	15,603	2,664
VET	Vet expenses per cow	$44.75	$33.95
CALF	Heifers and Calves per cow	.78	.26
MMAN	Milk sold per man (lbs)	489,655	187,406
Crop Management Indicators			
ACOW	Crop acres per cow	3.3	1.6
AMAN	Crop acres per man	99.2	48.4
EXP	Crop expenses per acre	$155.46	$75.84
YLDS	Farm Relative Crop Yield Index	−0.019	3.130
Scale/Size Measure			
HS	Herd size (cows)	70.8	43.9

*Source: Pennsylvania Farmers' Association, 1990, 880 farms.

pMLE parameters only requires the first and second derivatives of the normal log likelihood function (White).

Empirical Results

The 35 parameters for the complete structural latent variable model were estimated using pMLE methods and are presented in Table 2. All parameter estimates are significantly different from zero at the five percent level with the exception of the covariance between the financial management factor and herd size, Φ_{14}, (significant at the ten percent level), the covariance between the financial and crop management factors, Φ_{13}, and the parameter estimate for crop management, ξ_c. Calculated standard errors use White's formula so that they are robust to distributional misspecifications. The estimated model explains 43 percent of the variation in net farm income in the sample. This is substantially better than the proportion of efficiencies explained in previous work (Tauer and Belbase; Tauer; Grisley and Mascarenhas), but equal to the explanatory power of the model developed by Weersink, et al.. An examination of the estimated parameters for the management factors in-

Table 2. Maximum Likelihood Estimation Results

Variable	Estimated Parameter	Estimated Value	Asymptotic Standard Error	Implied T-Value	Correlation of Indicator with Factor
ξ_f	γ_1	0.396	0.048	8.18*	—
ξ_d	γ_3	4.394	0.877	5.01*	—
ξ_c	γ_3	−0.189	0.748	−0.25	—
HS	γ_4	4.161	0.469	8.87*	—
EA	N[a]	1	—	—	.901
MARG	λ_1	0.209	0.023	9.02*	.332
INT	λ_2	−0.266	0.013	−20.11*	−.798
DEBT	λ_3	−0.093	0.004	−22.71*	−.981
MCOW	N	1	—	—	.855
VET	λ_4	0.676	0.091	7.46*	.454
CALF	λ_5	0.296	0.049	6.03*	.262
MMAN	λ_6	3.742	0.844	4.43*	.455
ACOW	N	1	—	—	.930
AMAN	λ_7	0.246	0.019	12.91*	.740
EXP	λ_8	−2.421	0.359	−6.75*	−.464
YLDS	λ_9	−0.554	0.116	−4.78*	−.258
$V_{\epsilon 11}$	—	101.99	13.00	7.84*	—
$V_{\epsilon 22}$	—	155.35	12.38	12.55*	—
$V_{\epsilon 33}$	—	17.79	1.46	12.22*	—
$V_{\epsilon 44}$	—	0.15	0.08	1.81*	—
$V_{\epsilon 55}$	—	1.91	0.90	2.11*	—
$V_{\epsilon 66}$	—	9.14	2.58	3.55*	—
$V_{\epsilon 77}$	—	6.14	0.46	13.25*	—
$V_{\epsilon 88}$	—	278.22	23.43	11.87*	—
$V_{\epsilon 99}$	—	0.33	0.17	1.92*	—
$V_{\epsilon 1010}$	—	0.11	0.01	8.89*	—
$V_{\epsilon 1111}$	—	45.06	4.78	9.43*	—
$V_{\epsilon 1212}$	—	9.13	0.55	16.74*	—
Φ_{11}	—	441.78	29.51	14.97*	—
Φ_{12}	—	−5.83	2.25	−2.59*	—
Φ_{13}	—	−1.40	1.52	−0.92	—
Φ_{14}	—	4.69	2.44	1.93**	—
Φ_{22}	—	5.19	0.95	5.43*	—
Φ_{23}	—	−0.41	0.16	−2.59*	—
Φ_{24}	—	1.49	0.68	2.20*	—
Φ_{33}	—	2.11	0.31	6.80*	—
Φ_{34}	—	−0.60	0.24	−2.49*	—
Φ_{44}[b]	—	19.27	—	—	—
Ψ	—	753.70	82.15	9.17*	—

*Denotes that the estimated parameter is significant at the five percent level. Variances are evaluated with one-sided tests.
**Denotes that the estimated parameter is significant at the ten percent level.
[a]N denotes that the factor loading was normalized to unity.
[b]The sample variance of the herd size variable.

dicates that herd size, financial management, and dairy management are highly significant regressors in explaining dairy net farm income. The sign of the estimated crop management parameter is negative, though quite insignificant. The interpretation of the crop management factor will be discussed later.

An implied correlation coefficient is also presented in Table 2 (Bollen, p. 288) to show how closely the indicators are related to the corresponding factor. The correlations of the financial management indicators with their factor exhibit the expected signs. Equity and profit margin are positively associated with financial management and debt and interest payments are negatively associated with financial management. The correlation of debt per cow with the financial management factor has the largest magnitude of the four indicators. This result suggests that farm financial structure is more important than profit margin as an indicator of financial management.

The loadings and correlations of the dairy management indicators are also what were expected a priori. All are positively associated with dairy management. Milk sold per cow has the strongest correlation with the dairy management factor, but milk sold per man has the largest factor loading (3.742), indicating the importance of labor efficiency in dairy operations. The parameter estimates for some crop management indicators appear to have signs that are in disagreement with a priori expectations. The positive loadings on acres per cow (ACOW) and acres per man (AMAN) and negative loadings on crop yields (YLDS) and crop expense per acre (EXP) show that the crop management factor varies positively with extensive crop operations and is inversely related to intensive crop operations. However, this does not suggest that larger crop operations relative to herd size and labor tend to increase dairy profitability, because the estimated parameter on the crop management factor is negative, through insignificant. Hence, there is inconclusive evidence that intensive as opposed to extensive crop operations are associated with greater dairy farm profitability.

The effects of the indicators on the financial success variable, net farm income, can also be shown as elasticities. These elasticities, evaluated at sample means, are presented in Table 3. They are assessed using Thomson's method of factor score estimation (Bollen, p. 304). In the case of the indicators of the ξ_i latent factors, the formula

$$\frac{\partial y}{\partial x_j} = \sum_{i=1}^{3} \frac{\partial y}{\partial \hat{\xi}_i} \frac{\partial \hat{\xi}_i}{\partial x_j} = \sum_{i=1}^{3} \hat{\gamma}_i \frac{\partial \hat{\xi}_i}{\partial x_j} \tag{13}$$

Table 3. Elasticity of Net Farm Income with Respect to Management Indicators (Evaluated at Sample Means)

Indicator	Elasticity
EA	0.111
MARG	0.005
INT	−0.020
DEBT	−0.220
MCOW	1.306
VET	0.053
CALF	0.060
MMAN	0.105
ACOW	−0.028
AMAN	−0.007
EXP	0.002
YLDS	0.00003
HS	0.922

is used because the latent factors are correlated. That is, Φ is specified to be non-diagonal and a change in an indicator can affect all latent factors. In fact, the correlation between ξ_d and ξ_c is estimated to be $-.125$ $(\hat{\Phi}_{23}/\hat{\Phi}_{22}\hat{\Phi}_{33})^{1/2})$ which implies that increases in dairy management are associated with decreases in crop efficiency (Table 4). This relates directly to the likely difficulty for farmers to manage both a high producing dairy herd and the production of high quality feed for the dairy operation. Note, however, that most of the indicators of ξ_c have little direct effect on net farm income.

Milk per cow has the largest effect on net farm income of all indicators with an elasticity of 1.306. Note that this response is even greater than changing herd size (0.992). In fact, the elasticity of herd size at less than unity suggests that this sample of dairy farms exhibits decreasing economies of size. Weersink and Tauer found that increasing herd size causes productivity increases (milk per cow) on dairy farms, although the causal effect was insignificant for Pennsylvania farms. While no causal relationship between herd size and dairy management can be developed from this research, the results suggest that increasing milk per cow and consequently dairy management has a greater proportional impact on net farm income than does herd size. The importance of debt management on farm financial success is seen in the magnitude of the effects of the equity to asset ratio (0.111) and debt per cow (−0.220). Increases in crop management indicators have little effect on net farm income, but an increase in labor efficiency (MMAN) has a modest effect.

Correlations among the management factors and herd size are presented in Table 4. All correlations are significantly different from zero at the five percent level except for the correlation between financial and crop management and the correlation between herd size and dairy management (significant at the ten percent level). All of the correlations are relatively low and are negative with two exceptions. The correlation between financial management and herd size and the correlation between dairy management and herd size are both positive. These results seem to support the notion that it is difficult for dairy farmers to be successful managers in the three managerial areas examined in this research: financial, dairy, and crop management. However, the positive correlations between herd size and financial management and dairy management suggest that financial success on large farms occurs only with good financial management. One can also draw the conclusion that large farms are successful if they have good dairy management.

Conclusions

The structural latent variable approach using confirmatory factor analysis allows the estimation of underlying relationships among unobserved variables and their observed indicators. The use of this approach has yielded several interesting insights into the relationships among dairy farm financial success and managerial ability in farm finances, the dairy operation, and crop production for a sample of Pennsylvania dairy farms.

Dairy management and herd size have been determined to be more important determinants of farm financial success than financial or crop management. In fact, indicators of crop managerial ability have a relatively low impact on farm success. Debt per cow is strongly negatively related to financial success. The result indicating decreasing economies of herd size suggests that increasing efficiency (dairy managerial ability) will have greater relative payoff than increasing herd size.

Table 4. Correlations Among Management Factors and Herd Size (standard errors in parentheses)

	ξ_f	ξ_d	ξ_c	HS
ξ_f	1			
ξ_d	−.122* (.061)	1		
ξ_c	−.046 (.052)	−.125* (.060)	1	
HS	.051* (.026)	.149** (.088)	−.094* (.034)	1

*Statistically significant at the five percent level.
**Statistically significant at the ten percent level.

The analysis of this farm records data set also illustrates the difficulty dairy farm managers have in managing all facets of the farm business. The results indicate that dairy, financial, and crop management abilities are all negatively correlated with one another. Consequently, an appropriate management strategy may be to put less managerial effort into crop production and more into dairy activities. This approach is consistent with farming practices on large dairies in the southern and western regions of the United States.

The results of this analysis are dependent on cross-sectional data for 1990. It is possible that a similar analysis for another year may generate different results. Changes in milk prices and interest rates, for example, may alter the relative magnitudes of the management factors. However, dairy farmers have organized their farm operations in response to historical patterns in price levels and any future changes in price levels will likely be uniform across the farms in this dataset.

The structural latent variable approach shows great promise for disentangling management from other farm measures in determining the factors that are necessary for farm financial success. The results of this analysis also point to the most important managerial abilities for the farm manager and which indicators of those abilities are most likely to result in the financial success of the dairy farm. Further, these methods can be applied to other types of farms and businesses to assess determinants of financial success.

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